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EXAMINER

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ART UNIT	PAPER NUMBER
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1753

8

DATE MAILED: 10/10/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.
09/458,581

Applicant

Pinarbasi

Examiner
Rodney McDonald

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Jul 23, 2002
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27, 29, 30, 32-34, 36-42, 44-49, 51-53, and 55-70 is/are pending in the application.
- 4a) Of the above, claim(s) 1-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 29, 30, 32-34, 36-42, 44-49, 51-53, and 55-70 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on Jul 23, 2002 is: a) ☒ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 1 6) ☐ Other:

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DETAILED ACTION

Election/Restriction

1. Claims 1-27 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made without traverse in Paper No. 4.

Drawings

2. The drawing corrections were received on July 23, 2002. These drawings corrections are approved by the Examiner.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi et al. (U.S. Pat. 5,492,605) in view of Okuno et al. (U.S. Pat. 5,616,370).

Pinarbasi et al. teach an ion beam sputter deposition system and method for fabrication of multilayered thin film structures. Selected combinations of ion beam gases and energies matched to the selected target materials optimize the physical, magnetic and electrical properties of the deposited thin film layers. (See Abstract)

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Referring now also to FIG. 2, a simplified block diagram illustrating an ion beam sputter deposition system constructed in accordance with the principles of the present invention is shown. The ion beam sputter deposition system 20 includes a vacuum chamber 22 in which an ion beam source 21 is mounted, a target 23 and a workpiece or deposition substrate 51. An ion beam 33 provided by the ion source 21 is directed at the target 23 where the impacting ions cause sputtering of the target material. Selectable, multiple targets 23 may be provided on a rotary target support 25. The sputtered atoms 26 emitted by the target material are directed onto a deposition substrate 31 on which is formed a layer of the target material. A thickness monitor positioned closely adjacent the substrate to provide real-time, in-situ monitoring of the thickness of the growing film during deposition. *The substrate or other workpiece 51 is mounted on a movable pedestal or support member 41* which is retrieved into a loading port 39 via a gate valve; 38 for changing the workpiece 51. The pedestal 41 may also be temperature controlled, i.e., heated or cooled or both. *A magnetic field may also be applied at the workpiece 31 if required for the particular structure being deposited.* The pedestal 41 may also be rotated by means of a linear/rotary motor drive (not shown). During operation, the vacuum chamber is maintained at an internal operation pressure on the order of 1×10^{-4} Torr by a vacuum pump (not shown) via port 35. (Column 4 lines 45-68; Column 5 lines 1-4)

In order to provide practical magnetoresistive (MR) read sensors for use in magnetic recording devices, it is desirable to optimize as much as possible the MR and magnetic properties of the materials, such as *NiFe*, for example, utilized for the MR element in the sensor structure. In

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the prior art, DC or magnetron sputter deposition, for example, it is critical to use a Ta underlayer with a NiFe layer to achieve sufficient MR response for MR sensor applications. In contrast, ion beam deposited NiFe films, both with and without Ta underlayers exhibit nearly identical values of MR and other magnetic properties. Eliminating the Ta underlayer dependence provides many more options and alternatives when designing an MR sensor. The characterization of the NiFe films included the measurement of electrical resistance (R), the change in R under an applied magnetic field (dR), and the ratio dR/R as well as the coercivity and anisotropy field ($H_{sub.k}$) of the film. NiFe films were deposited both with a Ta underlayer and directly on glass substrates. The bilayer structures (NiFe/Ta) having 50 and 100 Å NiFe films show a lower magnetoresistance compared to the NiFe films deposited directly on glass substrates because the Ta underlayer carries a significant portion of the measuring current. For NiFe layers greater than 250 Å thickness, the Ta underlayer no longer contributes to this effect. These films exhibited a relatively low $H_{sub.c}$, $H_{sub.k}$ and sheet resistance while having a relatively good magnetoresistance. Magnetostriction measurements showed a value of 0.25×10^{-6} for a 267 Å thick NiFe film. (Column 8 lines 18-48)

Soft magnetic films of *nickel-iron-rhodium (NiFeRh)* were also deposited using ion beam deposition and the electrical and magnetic properties evaluated. The NiFeRh films exhibited relatively good magnetoresistance and sheet resistance. The magnetoresistance of a 100 Å thick NiFeRh film was measured to be only 0.192 Ohms/square while the sheet resistance was found to

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be 43.5 Ohms/square. Magnetostriction measurements showed a value of 0.13×10^{-6} for the 100 ANG thick NiFeRh film. (Column 8 lines 49-58)

Referring now also to FIG. 7, a trilayer MR structure comprising a soft magnetic layer 76, a spacer layer 74 and an MR layer 72 is formed on substrate 78 by ion beam deposition as described above. The magnetic and electrical properties of an ion beam sputtered trilayer structure 70 comprising a thin film soft magnetic layer of NiFeRh 76, a thin film spacer layer of Ta and a thin film MR layer of NiFe deposited on substrate 78 was analyzed for various combinations of layers of different thicknesses. (Column 9 lines 33-42)

Referring now also to FIGS. 8a and 8b, FIG. 8a illustrates an MR sensor 80 of the type described in U.S. Pat. No. 5,014,147 comprising a multilayer MR structure 80 having a soft magnetic layer 77, a spacer layer 79, an MR layer 82 and a longitudinal bias layer 84 deposited on a substrate 75. Conductor leads 92 deposited over the end regions of the longitudinal bias layer 84 provide electrical connection of the MR sensor to external circuitry (not shown). (Column 10 lines 16-24)

In a preferred embodiment, a multilayer MR sensor, such as MR sensors 80, 90, fabricated utilizing ion beam deposition techniques as described hereinbelow, comprises a soft magnetic layer 77 of NiFeRh, a spacer layer 79 of Ta and an MR layer 82 of NiFe deposited on a substrate 75. The longitudinal bias layer 84 is a hard bias layer, as is well known in the art, such as a layer of *CoPtCr*, *CoCr* or *CoPt* deposited in end regions of the MR layer 82 as described in U.S. Pat. No. 5,018,057 to Krounbi et al. (Column 10 lines 38-47)

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For soft magnetic layer 77, NiFeRh or NiFeCr or other suitable soft magnetic material may be used. For the MR layer 82, ferromagnetic materials such as *Ni, Fe, Co and alloys thereof*, NiFe and NiFeCo, for example, or other suitable materials may be used. For the spacer layer 79, tantalum (hcp phase), *Al.sub.2 O.sub.3, SiO.sub.2 and oxide compounds of tantalum*, such as Ta.sub.2 O.sub.5, can be used. Materials, such as Ta, having a suitable crystalline structure which promotes the desired MR layer 82 growth are preferable for the spacer layer 79. (Column 10 lines 57-68)

The primary ion source comprises a 12 cm Kaufman ion source adjustably mounted to provide a variable angle of incidence of the ion beam on the target 91 over a range of 0 degrees, i.e., normal to the target, to about 60 degrees. (Column 12 lines 46-49) *Oblique sputtering occurs in the range of 0 to 60 degrees.*

The difference between Pinarbasi and the present claims is applying a magnetic field to orient the magnetic film is not discussed and annealing after depositing is not discussed.

Okuno et al. teach an artificial multilayer in which ferromagnetic layers and nonmagnetic layers are alternatively laminated, wherein a uniaxial magnetic anisotropy is introduced into the ferromagnetic layers in a predetermined direction, thereby controlling the gradient of the relative change of resistivity to the change of external magnetic field. *The uniaxial magnetic anisotropy is introduced into the ferromagnetic layers by applying a magnetic field along the surface of ferromagnetic layers during the formation thereof.* (See Abstract)

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In the present invention, a ferromagnetic layer consists of at least one selected from a group of transition metals such as Fe, Co, Ni, and their alloys and compounds. (Column 3 lines 56-60)

FIG. 1A shows an ion beam sputtering apparatus used in this example. An exhaust port 2 of a chamber 1 is connected to a vacuum pump (not shown), and the pressure in the chamber 1 is measured by a pressure gauge 3. A substrate holder 4 is installed in the chamber 1, and a substrate 5 is held on the substrate holder 4. A heater 6 is provided in the substrate holder 4, and cooling water 7 is flowed near the substrate holder 4 to regulate the temperatures of the substrate holder 4 and the substrate 5. The temperature of the substrate holder 4 is measured with a thermocouple 8. Means for applying magnetic field 9 is provided near the substrate 5 to apply a magnetic field along the surface of a layer to be formed on the substrate 5. A shutter 10 is provided in front of the substrate 5. A target holder 11 is rotatably provided at a position opposed to the substrate 5, and a plurality of targets 12 are mounted on the surface of target holder 11. The target holder 11 is cooled by cooling water 13. An ion gun 14 is provided at a position opposed to the targets 12, and Ar gas 15 is supplied to the ion gun 14. (Column 5 lines 44-62)

An artificial multilayer having layers of Fe/Cr was manufactured by using an ion beam sputtering apparatus shown in FIG. 1A. As the substrate 5, quartz glass was employed. Two types of targets 12 made of Fe and Cr were mounted on the target holder 11. The chamber 1 was exhausted up to 2×10^{-7} Torr, and then Ar gas was introduced into the ion gun 14 to set the pressure to 3×10^{-4} Torr. Ar was ionized and accelerated, and then emitted to the

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target 12 with the energy of 500 eV. The temperature of the substrate was varied from a room temperature to 400.degree. C. Two types of targets were rotated at each predetermined time to alternatively laminate Fe layer 102 and Cr layer 103 on the quartz glass substrate 21, as shown in FIG. 2, thereby manufacturing an artificial multilayer. During this process, a magnetic field of 100 Oe was applied to the layers by a pair of permanent magnets 16 shown in FIG. 1B to introduce a uniaxial magnetic anisotropy in a predetermined direction in the surface of the layers (Example 1). (Column 6 lines 3-20)

Then, the artificial multilayer *was heat treated* at 50.degree. C. in vacuum in a magnetic field. With regard to the obtained artificial multilayer, the saturated magnetic field was reduced to 2.2 kOe when the external magnetic field was applied in the direction of easy axis, while was increased to 3.2 kOe when the external magnetic field was applied in the direction of difficult axis. (Column 8 lines 27-33) (*Annealing after depositing*)

The motivation for applying a magnetic field is that it allows for introducing uniaxial magnetic anisotropy. (See Abstract) The motivation for annealing after depositing is that it allows for alter the magnetic properties of the film. (Column 8 lines 27-33)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Pinarbasi by utilizing a magnetic field and post annealing as taught by Okuno et al. because it allows for introducing uniaxial magnetic anisotropy and for altering the magnetic properties of the film.

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5. Claims 32, 33 and 36-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi (U.S. Pat. 5,492,605) in view of Lin (U.S. Pat. 5,768,071), Okuno et al. (U.S. Pat. 5,616,370) and Tan et al. (U.S. Pat. 5,962,080).

Pinarbasi is discussed above and teach oblique ion beam sputtering of magnetic layers containing cobalt for magnetic sensors. A magnetic field can be used near the workpiece. (See Pinarbasi discussed above)

The difference between Pinarbasi and the present claims is that a spin valve sensor is not discussed, orienting the magnetic field so that uniaxial anisotropy is achieved along the easy axis is not discussed and the angles is not discussed.

Lin teach a spin valve sensor shown in FIGS. 8 and 9 has a ferromagnetic free layer 110, a nonmagnetic electrically conductive spacer layer 114, and a pinned ferromagnetic layer 112. A capping layer 127, such as Ta or other commonly used protective material, may cover the free layer 110. A ferromagnetic flux keeper layer may be employed in another embodiment, and may be comprised of materials such as NiFe, NiFeCr, NiFeRh, NiFeNb, or any other alloy having similar performance capabilities. The flux keeper layer preferably covers the capping layer 127. The spacer layer 114 is sandwiched between the free layer 110 and the pinned layer 112. In one embodiment, a ferromagnetic Co layer may be sandwiched between either the free layer 110 and the spacer layer 114, or between the pinned layer 112 and the spacer layer 114. The antiferromagnetic layer 122 abuts the nonmagnetic intermediate layer 116 and pins the magnetization 124 of the pinned layer 112 in a direction perpendicular to the ABS. The

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nonmagnetic intermediate layer 116 may be very thin, in the order of 0.5 nm, continuous or discontinuous, and does not significantly impede the antiferromagnetic exchange coupling between the antiferromagnetic layer 122 and the pinned layer 112. (Column 5 lines 26-47)

FIG. 10 shows a simplified illustration of the spin valve sensor 53a shown in FIGS. 8 and 9. The illustration generally indicates the relative physical orientation of each layer used in one embodiment of the current invention. The antiferromagnetic layer 1010 may be considerably thicker than any of the other layers, which include a discontinuous intermediate layer 1007, ferromagnetic layers 1008 and 1006, a spacer layer 1004, a free layer 1003, and a protective top layer 1002. Although each of the layers may be comprised of a suitable material well known to one skilled in the art, the layers preferably comprise a Cu intermediate later 1007, a NiFe layer 1008, a Co layer 1006, a NiFe free layer 1003, a Ta protective layer 1002, a Cu spacer layer 1004, and a NiO antiferromagnetic layer 1010. (Column 6 lines 22-36)

Exemplary materials for the spin valve sensors 53a and 53b are NiFe for the free layer 110, Cu for the spacer layer 114, Co, NiFe, NiFe/Co for the pinned layer 112, Cu for the intermediate layer 116, and Ta for the capping layer 127. NiO is preferred for the antiferromagnetic pinning layer 122, although other materials interacting similarly with the nonmagnetic layer 116 and the pinning layer 112, as well as spacer layer 114 and the free layer 110, may be used. For example, cobalt oxide, nickel oxide, iron oxide, iron sulfide, iron manganese, or oxide solutions thereof, amongst others, may suffice. The intermediate layer 116

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may alternatively comprise Au, Ag, or other nonferromagnetic material having high conductivity.

(Column 8 lines 5-17)

The motivation for forming a spin valve sensor is that it allows for reading magnetic media. (Column 1 lines 12-14)

Okuno et al. is discussed above and teach utilizing a magnetic field in the vicinity of the substrate for achieving uniaxial magnetic anisotropy and post annealing of the magnetic films. (See Okuno et al. discussed above) Okuno et al. teach heating from room temperature to 400 degrees C. (Column 6 lines 11-12)

The motivation for utilizing a magnetic field in the vicinity of the substrate is that it allows for achieving uniaxial magnetic anisotropy. (See Okuno et al. discussed above) The motivation post annealing is that it allows for improving magnetic properties. (See Okuno et al. discussed above)

Tan et al. teach oscillating the target and the substrate to achieve the ion beam sputtered angles. (Column 3 lines 49-53; Column 4 lines 65-68)

The motivation for utilizing angles is that it allows for depositing films with uniformity in thickness. (Column 2 lines 52-56)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Pinarbasi by forming a spin valve sensor as taught by Lin, by utilizing a magnetic field in the vicinity of the substrate and post annealed as taught by Okuno et al. and utilized angles as taught by Tan et al. because it allows for reading magnetic materials,

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providing uniaxial anisotropy and improving magnetic properties and for depositing films with uniformity in thickness.

6. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi in view of Lin and Okuno et al. and further in view of Tan et al. as applied to claims 32, 33 and 36-39 above, and further in view of Fujikata et al. (U.S. Pat. 5,766,743).

The difference not yet discussed is utilizing two layers for the pinning layer structure.

Fujikata et al. teach utilizing an antiferromagnetic thin film comprised of a two-layer structure composed of a CoO layer deposited on a NiO layer. (See Abstract) As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe₂O₃, FeO, CrO, and MnO are preferred. (Column 6 lines 2-5)

The motivation for utilizing a two layer structure is that it allows for avoiding Barkhausen jumps. (Column 6 line 1)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a two layer structure as taught by Fujikata et al. because it allows for avoiding Barkhausen jumps.

7. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (U.S. Pat. 5,768,071) in view of Fujikata et al. (U.S. Pat. 5,766,743) and Pinarbasi (U.S. Pat. 5,492,605).

Lin is discussed above and teach a magnetic head and spin valve sensor. (See Lin discussed above)

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The difference between Lin and the present claims is that the pinning layer being a dual layer of NiO and alpha FeO is not discussed and oblique ion beam sputtering is not discussed.

Fujikata et al. teach depositing a dual layer NiO and FeO layer. (See Fujikata discussed above)

The motivation for utilizing a dual layer NiO and FeO layer is that it allows for avoiding Barkhausen jumps. (See Fujikata discussed above)

Pinarbasi is discussed above and teach oblique ion beam sputtering for oxides. (See Pinarbasi discussed above)

The motivation for utilizing oblique ion beam sputtering is that it allows for minimizing the internal stresses in the deposited films. (Column 2 lines 27-30)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lin by utilizing a dual layer as taught by Fujikata and to have obliquely sputtered as taught by Pinarbasi because it allows for avoiding Barkhausen jumps and for minimizing internal stresses in deposited films.

8. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (U.S. Pat. 5,768,071) in view of Pinarbasi (U.S. Pat. 5,492,605) and Okuno et al. (U.S. Pat. 5,616,370).

Lin is discussed above and teach forming a spin valve structure. (See Lin discussed above)

The difference between Lin and the present claims is that oblique sputtering is not discussed.

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Pinarbasi is discussed above and teach oblique sputtering. (See Pinarbasi discussed above)

The motivation for utilizing oblique ion beam sputtering is that it allows for minimizing the internal stress in the deposited films. (See Pinarbasi discussed above)

Okuno et al. is discussed above and teach annealing and applying a magnetic field after deposition. (See Okuno et al. discussed above)

The motivation for annealing and applying a magnetic field after depositing is that it allows for altering the magnetic properties of the film. (See Okuno et al. discussed above)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lin by utilizing oblique ion beam sputtering as taught by Pinarbasi and to have annealed and applied a magnetic field after depositing as taught by Okuno et al. because it allows for minimizing the internal stress in the deposited films and allows for altering the magnetic properties of the film.

9. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Pinarbasi and Okuno et al. as applied to claim 41 above, and further in view of Fujikata et al. (U.S. Pat. 5,766,743).

The difference not yet discussed is utilizing a dual layer structure.

Fujikata et al. teach utilizing a dual layer structure. (See Fujikata et al. discussed above)

The motivation for utilizing a dual layer structure is that it allows for minimizing Barkhausen jumps. (See Fujikata et al. discussed above)

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Therefore, it would have been obvious to utilize a dual layer structure as taught by Fujikata et al. because it allows for minimizing Barkhausen jumps.

10. Claims 44-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Pinarbasi and further in view of Fujikata et al. and Okuno et al. as applied to claims 41 and 42 above, and further in view of Tan et al. (U.S. Pat. 5,962,080).

The difference not yet discussed is oblique sputtering at different angles.

Tan et al. is discussed above and teach oblique sputtering at different angles. (See Tan et al. discussed above)

The motivation for oblique sputtering at different angles is that it allows for depositing films with uniformity in thickness. (Column 2 lines 52-56)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized oblique sputtering at different angles as taught by Tan et al. because it allows for depositing films with uniformity in thickness.

11. Claims 48-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (U.S. Pat. 5,768,071) in view of Pinarbasi et al. (U.S. Pat. 5,492,605) and Okuno et al. (U.S. Pat. 5,616,370).

Lin is discussed above and teach forming a spin valve sensor. (See Lin discussed above)
Lin further teach making a write and read head as seen in Figure 5. (See Lin discussed above)

The difference between Lin and the present claims is that oblique sputtering is not discussed and utilizing a magnetic field to orient the magnetic layers is not discussed.

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Pinarbasi is discussed above and teach oblique ion beam sputtering. (See Pinarbasi discussed above)

The motivation for oblique ion beam sputtering is that it allows for depositing films with uniformity in thickness. (See Pinarbasi discussed above)

Okuno et al. is discussed above and teach utilizing a magnetic field (See Okuno et al. discussed above)

The motivation for utilizing a magnetic field is that orients the film uniaxially. (See Okuno et al. discussed above)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lin et al. by utilizing oblique ion beam sputtering as taught by Pinarbasi and to have utilized a magnetic field as taught by Okuno et al. because it allows for depositing films with uniformity in thickness and orients the films uniaxially.

12. Claims 52 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin et al. in view of Pinarbasi and Okuno et al. as applied to claims 48-51 above, and further in view of Tan et al. (U.S. Pat. 5,962,080).

The differences not yet discussed is that utilizing different angles is not discussed.

Tan et al. is discussed above and teach utilizing different angles. (See Tan et al. discussed above)

The motivation for depositing at different angles during oblique sputtering is that it allows for depositing films with uniformity in thickness. (See Tan et al. discussed above)

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Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized different angles for oblique sputtering as taught by Tan et al. because it allows for depositing films with uniformity in thickness.

13. Claims 55-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi (U.S. Pat. 5,492,605) in view of Tan et al. (U.S. Pat. 5,962,080).

Pinarbasi is discussed above and teach obliquely sputtering at least one material layer from a target to form onto a substrate a magnetic layer or a antiferromagnetic layer. (See Pinarbasi et al. discussed above)

The differences between Pinarbasi et al. and the present claims is that the angles are not discussed.

Tan et al. is discussed above and teach utilizing different angles. (See Tan et al. discussed above)

The motivation for depositing at different angles during oblique sputtering is that it allows for depositing films with uniformity in thickness. (See Tan et al. discussed above)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized different angles for oblique sputtering as taught by Tan et al. because it allows for depositing films with uniformity in thickness.

14. Claims 60, 61, 62, 63 and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi in view of Tan et al. as applied to claims 55-59 above, and further in view of Fujikata et al. (U.S. Pat. 5,766,743).

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The differences not yet discussed is the layers of materials deposited to form the electrical device.

Fujikata et al. teach in Fig. 27 a magnetoresistance effect device. The magnetoresistance effect device comprises an underlying layer 21, a Ni oxide layer 22, a Co oxide layer 23, a first ferromagnetic layer 24, a first MR enhance layer 25, a nonmagnetic layer 26, a second MR enhance layer 27, a second ferromagnetic layer 28 and a protective layer 29 successively stacked on the underlying layer 21. (Column 14 lines 12-20)

The first ferromagnetic layer can be NiFe. The first MR enhance layer can be NiFeCo. (Column 14 lines 27-32) At Column 6 lines 2-5 the Co oxide or Ni oxide can be replace by iron oxide.

The motivation for utilizing different layers of materials is that it allows for producing a magnetic device that is excellent in corrosion resistance, exchange-coupling magnetic field, hysteresis characteristics, MR ratio, cross point and half-width of an output signal. (Column 4 lines 4-8)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have selected the layers for the electrical device as taught by Fujikata et al. because it allows for producing a magnetic device that is excellent in corrosion resistance, exchange-coupling magnetic field, hysteresis characteristics, MR ratio, cross point and half-width of an output signal.

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15. Claims 65-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi in view of Tan et al. and further in view of Fujikata et al. as applied to claims 55-64 above, and further in view of Okuno et al. (U.S. Pat. 5,616,370).

The differences not yet discussed is the use of a magnetic field and annealing in a magnetic field after sputtering.

Okuno et al. is discussed above and teach the use of a magnetic field and annealing in a magnetic field after sputtering. (See Okuno et al. discussed above)

The motivation for the use of a magnetic field and annealing in a magnetic field after sputtering is that it allows for achieving uniaxial magnetic anisotropy and for improving magnetic properties.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a magnetic field and annealed in a magnetic field after sputtering as taught by Okuno et al. because it allows for achieving uniaxial magnetic anisotropy and for improving magnetic properties.

Response to Arguments

16. Applicant's arguments filed 7-23-02 have been fully considered but they are not persuasive.

In response to the argument that Tan does not teach angles orthogonal, it is argued that the combination of target movement and rotational angular movement of the substrate will achieve the desired angles. (See Tan et al. discussed above)

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In response to the argument that Okuno et al. does not teach forming the cobalt or cobalt based layer in the presence of a magnetic field and annealing after ion beam sputtering, it is argued that Pinarbasi et al. teach at Column 4 lines 45-68 and Column 5 lines 1-4 that a magnetic field may be applied to the workpiece. Okuno et al. in the Abstract teach applying a magnetic field during the formation of the ferromagnetic layers. Okuno et al. At Column 8 lines 27-33 teach annealing after ion beam sputtering in the presence of a magnetic field. (See Pinarbasi et al. and Okuno et al. discussed above)

In response to the argument that the references do not teach utilizing a nickel oxide and an alpha iron oxide layer as part of the pinning layer structure, it is argued that Fujikata et al. suggest utilizing a two layer structure of NiO and iron oxide as antiferromagnetic material which can be used in the pinned structure of Lin. (See Fujikata et al. and Lin discussed above)

Conclusion

17. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP. § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR


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1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M-F from 8 to 5. The examiner can also be reached on alternate .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen, can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is 703-305-3599.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.


RODNEY G. MCDONALD
PRIMARY EXAMINER

RM

May 8, 2002